HYDRONEPHROSIS DUE TO THE INFERIOR POLAR ARTERY: LATE RESULTS AFTER NEPHROPLICATION.

Appendix of Recent Cases

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For hydronephrosis due to an aberrant, inferior polar artery, nephropllication has stood the test of time. The condition was discussed in an earlier communication (Adams, 1951) around a report of fourteen cases and, after a lapse of five years or more, is again reviewed. The writer's purpose is to clarify further the vascular import and the mechanics of the lesion and, by a study of the later results of the operation, to substantiate the value of it. In an appendix, pyelograms of a current series further illustrate restoration of the kidney to efficient form and function.

The aberrant artery has been a controversial topic as a cause of hydronephrosis because it is often found crossing harmlessly in front of or, occasionally, behind the ureter. With equal certainty, however, as already reported (Adams, 1951), it was proved responsible for gross hydronephrosis in S. P., a female of 4 years.

PATHOLOGY

The Mechanics of Arterial Interference with Renal Outflow.—Recent researches by Graves (1956) shed light on the development of the arterial supply to the kidney and show that the aberrant artery is not a supernumerary vessel, but merely the segmental branch to the lower pole arising from the parent trunk at a variable distance proximal to the hilum, or springing directly from the aorta and retaining its separate origin as one of the five primitive segmental arteries which supply the embryonic mesonephros. Derived at a distance from the kidney and running a slanting course to the lower pole, it is liable to be dragged upon and become entwined with the ureter when the kidney slides down and tilts forwards at its upper pole. The main pedicle, going to the hilum more horizontally, crosses at a higher level harmlessly in front of the upper part of the pelvis. The normal subphrenic excursion increases when a person in the erect position inspires deeply or flexes the spine and, thus, where the inferior polar artery crosses the ureter it tends to compress it and cause a variable degree of renal retention. The incidence of symptoms is less in infancy, but constriction tightens in the second and third decades when the weight of the kidney and maximal physical activities of the patient increase the pull on the anchoring vascular pedicle. Every time the distended pelvis descends, the initial 1.5 cm. of the ureter follow, but the next segment of the tube is restrained by the tethering action of the aberrant artery crossing it. A double bend of the first few centimetres of the ureter results (Fig. I). Spontaneous untwisting follows, though diminishingly, as attacks recur.

Secondary Pathology.—Inflammatory exudate about the intersecting artery and ureter increases as the attacks intensify: fibrosis around the lower pelvis fixes the kink in the ureter and the hydronephrosis becomes permanent. Ultimately a tunnel stricture develops in the ureter for 1 to 2 cm., and the renal cortex is stretched to a thin shell.

Infection is prone to complicate stasis. *Bacillus coli* pyelonephritis was found in five out of the fourteen cases followed up five years or more.

Can Cortical Circulation escape after Division of the Aberrant Vessels?—Although arteriotomy has often relieved their pain, the resulting ischaemia has doubtless deprived patients
of some 20 per cent. of a very valuable organ. However, the case of S. P. (Adams, 1951) affords strong evidence that impaired growth of the kidney is not an invariable sequel. Her hydronephrosis was treated solely by division of an offending inferior polar artery and, when intravenous pyelography was repeated at 11 years of age (Fig. 2), the former gross hydronephrosis was replaced by a perfect replica of the normal opposite pelvis; and the lower pole appears well developed.

Possibly the rete arteriosum urogenitale which Felix (1912) described in the segmental arteries of the mesonephros provides a rational explanation for such a favourable outcome. The aortic roots of these segmental vessels occasionally survive and therefore there is a reasonable possibility that their distal arteriolar anastomoses do the same and open up compensatory lower polar circulation, if the aberrant artery is divided.

DIAGNOSIS

Clinical Features.—The disease occasionally occurs in infancy but, characteristically, the age incidence is in the second to fifth decades. Symptoms consist of aching or attacks of colic in the loin, often with vomiting, but usually without changes in the urine. There is tenderness and, sometimes, swelling to be felt during the attacks, but these signs are slight or absent between them. There is one bilateral case among the thirteen patients in the five years’ follow-up, and one in the six patients in the Appendix of Recent Cases.

Pyelographical.—Typically there is mild calyceal dilatation and a tense-looking, markedly ovoid pyelectasis. The pelvi-ureteric junction is of two types: the ureter may show an "S" bend, the artery occupying the distal concavity (see Fig. 1); or the actual junction is hidden behind the base of the ovoid hydronephrosis from which the ureter drops vertically, the whole appearance

![Fig. 1](image1.png)

D. P., aged 27 years. Left hydronephrosis. Pre-operative retrograde pyelo-ureterogram showing "S" bend due to compression by aberrant artery.

![Fig. 2](image2.png)

S. P., aged 4 years. Right hydronephrosis.
A. Pre-operative retrograde pyelogram, 1932.
B. Post-operative intravenous pyelogram, 1939.
HYDRONEPHROSIS DUE TO THE INFERIOR POLAR ARTERY

FIG. 3

C. S., aged 13 years. Artist's drawings at operation—ureteric compression by aberrant artery; release of ureter; kidney lower pole folded to upper, carrying artery to upper level of pelvis.
being “tulipiform” (see Fig. 5, A). Renal excretion of dye is usually in abeyance for a few days after colic and in advanced pathology for weeks or persistently; pictorial diagnosis is then made by retrograde pyelography (see Fig. 13).

TREATMENT

Although detailed description of nephroplication was given in the previous communication (Adams, 1951), it may be well to repeat that, besides merely disentwining the artery and ureter, the surgeon needs to do a delicate and persevering dissection to liberate the lower half of the pelvis and adjacent ureter from fibrous perinephritis. This is especially exacting in the chronic case. The kidney, flaccid with its pelvis emptied, folds easily across its middle. The plicated state is now stabilised by encircling it with ribbon catgut instead of fascia lata. The stages of the procedure are shown in sketches (Fig. 3, A to F) made by my artist colleague, Dr Gillian Peacock, during a recent operation on the patient, C. S., whose pre-operative and post-operative pyelograms are reproduced (see Fig. 12).

When, despite bilateral pathology, the symptoms are only unilateral, the affected side should be done first even though it has the smaller hydronephrosis. Curing this will help to gain the patient's consent to early correction of the opposite kidney.

Preservation of the Artery by an Alternative Method.—It is well for the surgeon to be armed with an alternative remedy in case he finds a rigid stricture has developed in the ureter. Such requires resection, and the ureter must be reunited to the pelvis in front of the polar vessels. This preserves the renal circulation intact, but has the disadvantage of risks attendant on opening the urinary tract, such as leakage, fistula, and stricture. These are, of course, well justified, if nephrectomy would leave the patient reliant on an opposite renal function of doubtful competence.

COMMENTARY ON LATE RESULTS IN FOURTEEN NEPHROPLICATIONS

The patients have been reviewed five to nine years after nephroplication, save for a minority in which failure was apparent earlier. The clinical and other data tabulated in a classified form are given in the table. Explanatory notes follow.

Nine Successful.—All but one of these consented to late pyelographic study and their pictures are reproduced alongside the corresponding hydronephroses (Figs. 4 to 10). The exception is Case 2, J. W., and her latest pyelogram (Fig. 4), sixteen months after operation, is shown as that of a cured case. She writes in 1957 that she is “perfectly well and cannot spare time away from her young family living in a remote village.”

Five Unsuccessful.—These were largely the result of immature judgment over the selection of cases. Thus, in Cases 6, 7, and 9 pain was somewhat unconvincing and pyelography showed only incipient dilatation, not a typical, tensely rounded ovoid pelvis and calycosis. Case 7 had mild hydronephrosis in a congenital solitary kidney which was an argument for exploring. The original pyelogram (1947) is missing, but there has been little alteration in form since nephroplication. Two days after her operation oliguria called for pyelostomy. The pelvis was full of clot, and uremia was grave for a time. She has now a bonny infant, and symptoms have been in abeyance since the operation.

The other two failures were already infected before operation, and details about them will be found in the section following.
Tabulated Data of Fourteen Cases Followed Up for Five Years or More after Nephroplication

<table>
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<tr>
<th>Case No.</th>
<th>Initials</th>
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<th>Urinary Infection</th>
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<td>-</td>
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**SUMMARY**

<table>
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**Coincident Urinary Infection.**—Five cases came with *B. coli* infection co-existing. That this does not always preclude the use of nephroplication is shown by the great benefit following it in a bilateral case, a woman with gross hydronephroses. These are appreciably smaller on pyelography (see Fig. 9) and, clinically, the patient rejoices over her abundant health since the double operation. She has a busy, happy life doing a full-time occupation at the age of 64 years, whereas her ten years prior to operation had been punctuated by disabling pyelocystitis. She remains symptom-free although *B. coli* are still present in the urine.

In Case 11, A. J. B., pyelography shows the reduced hydronephrosis five years after plication and the patient was clinically very well.

The other two infected cases are failures. Unfortunately, in Case 10, a woman of 40 years, radiograms have been destroyed and the patient cannot be traced. However, her notes record that five months after operation pyelography showed "right hydronephrosis much as before operation."
Fig. 4
J. W. Left hydronephrosis. Typical pre-operative and post-operative pyeolograms of successful case.

Fig. 5
HYDRONEPHROSIS DUE TO THE INFERIOR POLAR ARTERY

FIG. 6
J. F. B. Left hydronephrosis. Typical pre-operative and post-operative pyelograms.

FIG. 7
E. S. Right hydronephrosis. Typical pre-operative and post-operative pyelograms.
A. J. B. Left hydronephrosis. Typical pre-operative and post-operative pyelograms.

S. G. Bilateral hydronephrosis; notable improvement in drainage; persists 1957.
A. Pre-operative. B. Post-operative.
The hydronephrosis in Case 12 was cured but not the infection, and acute pyelonephritis necessitated nephrectomy a year later. The fascial belt was found blended with the capsule and the pelvis was of normal size.

Caution must be exercised in recommending operation where urinary infection co-exists. Emphatically, a typical story of colicky pain and a pyelogram displaying obvious globar distension of the pelvis are pre-requisites, and prognosis will be guarded.

**APPENDIX OF RECENT CASES**

A recent series of six nephroplications gives up-to-date confirmation of the efficacy of the operation, all the cases being clinical successes. They provide further features of interest also in the study of the procedure. Ribbon catgut, 1.25 cm. wide, has proved a satisfactory substitute for the strip of fascia lata formerly used to maintain the kidney in its folded state. A series of pre-operative and post-operative pyelograms is shown below.

Case 1, S. B., aged 14 years, had both kidneys obstructed. Colic was, however, only felt on the side of the smaller hydronephrosis. This was plicated. She then agreed to operation on the right side and is well pleased with both results (Fig. 11, A and B).

Case 2, J. A., a quarryman aged 48 years, came with recurrent colic (right) for twenty-three years. On radiography a non-functioning kidney was found. At operation, a hydronephrosis of about 60 ml. capacity and due to a large aberrant vessel was treated by plication. This cured him and he has continued to work happily ever since. But post-operatively there was still no convincing pyelographic shadow. He consented to retrograde pyelography and the result was gratifying.

In Case 3, C. S., a girl of 13 years, the stages of the operation (31st May 1957) were sketched (see Fig. 3, A to F). Her pyelograms are shown (Fig. 12).

In Case 4, D. W., aged 32 years, the pre-operative pyelograms were surprisingly different. Whereas evidence of hydronephrosis was somewhat dubious by the intravenous route, it was convincingly clear in the retrograde picture. A large aberrant artery was the aetiological factor found at operation. An uncommon complication marred the early post-operative stage. She had severe pain for the first two days which ended dramatically with the passage of blood and clots in her urine, evidently the result of intrarenal haemorrhage.

In Case 5, G. G., aged 28 years, the regrouped cluster of calyces post-operatively is somewhat drooping, which is unusual. The reduction of pelvic stasis is satisfactory (Fig. 14). In Case 6, E. N. M. R., the dye is appearing early after injection and the pyelogram indicates development of excretory power in a kidney previously non-functioning and, at operation, like a thin-walled bag (Fig. 13).
S. B., aged 14 years. Right and left hydronephrosis; views before and after nephroplication.

C. S., aged 13 years (see also Fig. 3). Left hydronephrosis. A and B show standard pattern of hydronephrosis due to the aberrant artery, and C post-operatively, remodelling with clustered calyces and reduced pelvis.
E. N. M. R., aged 24 years. Right hydronephrosis. Shows standard pattern of hydronephrosis due to the aberrant artery, and post-operatively, remodelling with clustered calyces and reduced pelvis. Incipient return of functional power is evident post-operatively.

A, Pre-operative intravenous pyelogram.  
B, Post-operative intravenous pyelogram.  
C, Pre-operative retrograde pyelogram.  
D, Post-operative retrograde pyelogram.
G. G., aged 28 years. Left hydronephrosis.
A shows standard pattern of hydronephrosis due to the aberrant artery, and B post-operatively, remodelling with clustered calyces and reduced pelvis.

SUMMARY

In the patient with a typical story of recurrent aching or colic in the loin, especially in the second to fourth decades, and whose pyelogram portrays hydronephrosis of characteristic pattern, the surgeon will infer an aberrant artery is the causal factor, and apply nephroplication as the appropriate remedy. It cures with minimal complications and maximal recoverable renal function, and has a good prognosis.

If bacillary infection co-exists, much judgment is called for in advising operation.

CONCLUSION

Evidence in this contribution indicates the efficacy of nephroplication for hydronephrosis caused by an aberrant artery to the lower pole of the kidney. Of fourteen cases followed up five to eight years, five were disappointing due to being unsuitable for nephroplication, or complicated by infection. Discounting these, the late results in nine are good. Further, in an appendix, six recent cases selected in the light of earlier experiences are added and the results are good in all.

Finally, I should like to record my cordial appreciation of generous help from Dr H. J. Middlemiss, Director of the Radiological Department of the United Bristol Hospitals, to whom I owe the pyelograms; and from Mr F. Godman, in charge of the medical photography in the University of Bristol, for his admirable part in furnishing prints for the illustrations. I am also greatly indebted to Dr Gillian Peacock, the artist, who contributed the illuminating sketches of the steps of the operation.

REFERENCES

(Philadelphia: Lippincott)